FORM PTO-1390 (REV. 5-93)	U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER **10191/1736**
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		U.S. APPLICATION NO. (If known, see 37 CFR 1.5) 09/786283

INTERNATIONAL APPLICATION NO. **PCT/DE99/02769**	INTERNATIONAL FILING DATE **1 September 1999 (01.09.99)**	PRIORITY DATE CLAIMED: **2 September 1998 (02.09.98)**

TITLE OF INVENTION
RADIO RECEIVER

APPLICANT(S) FOR DO/EO/US
Andreas RITSCHEN and Rainer WITTIG

Applicants herewith submit to the United States Designated/Elected Office (DO/EO/US) the following items and other information.

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) immediately rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have. been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)) (unsigned).
10. ☒ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.
14. ☒ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information: International Search Report (translated), Preliminary Examination Report and PCT/RO/101.

EXPRESS MAIL NO.: EL594611594US

U.S. APPLICATION NO (if known, see 37 C.F.R.1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
09/786283	PCT/DE99/02769	10191/1736

17. ☒ The following fees are submitted:

	CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5)): Search Report has been prepared by the EUROPEAN PATENT OFFICE or JPO $860.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) $690.00		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) $710.00		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO $1,000.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) $100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 860	
Surcharge of $130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

Claims	Number Filed	Number Extra	Rate		
Total Claims	5 - 20 =	0	X $18.00	$ 0	
Independent Claims	1 - 3 =	0	X $80.00	$ 0	
Multiple dependent claim(s) (if applicable)			+ $270.00	$	
TOTAL OF ABOVE CALCULATIONS =				$ 860	
Reduction by ½ for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).				$	
SUBTOTAL =				$ 860	
Processing fee of $130.00 for furnishing the English translation later the ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$	
TOTAL NATIONAL FEE =				$ 860	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property +				$	
TOTAL FEES ENCLOSED =				$ 860	
				Amount to be: refunded	$
				charged	$

a. ☐ A check in the amount of $_____ to cover the above fees is enclosed.

b. ☒ Please charge my Deposit Account No. 11-0600 in the amount of **$860.00** to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 11-0600. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

By: Richard L. Mayer (Reg. No. 41,172)

Richard L. Mayer

SIGNATURE

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Richard L. Mayer, Reg. No. 22,490
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3/2/01
DATE

EXPRESS MAIL CERTIFICATE

"EXPRESS MAIL" MAILING LABEL NUMBER EL594611594US

DATE OF DEPOSIT 3/2/01

TYPE OF DOCUMENT National Phase

RE: RITSCHEN, Andreas, et al.

SERIAL NO. To be assigned FILING DATE Herewith

I HEREBY CERTIFY THAT THIS PAPER OR FEE IS BEING DEPOSITED WITH THE UNITED STATES POSTAL SERVICE "EXPRESS MAIL POST OFFICE TO ADDRESSEE" SERVICE UNDER 37 CFR 1.10 ON THE DATE INDICATED ABOVE, BY BEING HANDED TO A POSTAL CLERK OR BY BEING PLACED IN THE EXPRESS MAIL BOX BEFORE THE POSTED DATE OF THE LAST PICK UP, AND IS ADDRESSED TO THE ASSISTANT COMMISSIONER FOR PATENTS, WASHINGTON, D.C. 20231.

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(SIGNATURE OF PERSON MAILING PAPER OR FEE)

Radio Receiver

[10191/1736]

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s)	:	RITSCHEN et al.
Serial No.	:	To Be Assigned
Filed	:	Herewith
For	:	RADIO RECEIVER
Art Unit	:	To Be Assigned
Examiner	:	To Be Assigned

Assistant Commissioner
for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT AND
37 C.F.R. § 1.125 SUBSTITUTE SPECIFICATION STATEMENT

SIR:

Please amend the above-identified application before examination, as set forth below.

IN THE SPECIFICATION AND ABSTRACT:

In accordance with 37 C.F.R. § 1.121(b)(3), a Substitute Specification (including the Abstract, but without claims) accompanies this response. It is respectfully requested that the Substitute Specification (including Abstract) be entered to replace the Specification of record.

IN THE CLAIMS:

On the first page of the claims, first line, change "What is claimed is:" to:
--What Is Claimed Is:--.

Please cancel original claims 1 to 7, without prejudice, in the underlying PCT Application No. PCT/DE99/02769, and cancel substitute claims 1-5, without prejudice.

Please add the following new claims:

EL594611594US

6. (New) A radio receiver device, comprising:

at least a first variably tunable tuning stage for a first receiving range and a second variably tunable tuning stage for a second receiving range, the first variably tunable tuning stage and the second variably tunable tuning stage being capable of being switched separately;

a receiving antenna connected to the first variably tunable tuning stage and to the second variably tunable tuning stage;

a frequency converter stage;

a changeover switch for providing an optional connection of one of the first variably tunable tuning stage and the second variably tunable tuning stage with the frequency converter stage;

a changeover device; and

a mixing oscillator for converting a received high-frequency signal into a defined intermediate frequency, wherein:

in accordance with an operation of the changeover device, the mixing oscillator is able to be changed over in a tuning range to one of the first variably tunable tuning stage and the second variably tunable tuning stage in such a way that for the first receiving range of the first variably tunable tuning stage an oscillation frequency of the first variably tunable tuning stage is capable of being set above a frequency to be received by a quantity of the defined intermediate frequency, and that for the second receiving range of the second variably tunable tuning unit an oscillation frequency of the second variably tunable tuning stage is capable of being set below the frequency to be received by the quantity of the defined intermediate frequency.

7. (New) The radio receiver according to claim 6, wherein:

the mixing oscillator includes an oscillator coil provided with a tap, and

the mixing oscillator can be changed over through one of a switching effective and switching ineffective of the tap.

8. (New) The radio receiver according to claim 6, further comprising:

a coupling capacitor; and

a switch, wherein:

the receiving antenna is capable of being switched effectively, respectively via the coupling capacitor and the switch, only for the one of the first variably tunable tuning stage and the second variably tunable tuning stage connected with the frequency converter stage via the changeover device.

9. (New) The radio receiver according to claim 6, wherein:

the first variably tunable tuning stage includes:

a first tunable tuning circuit,

a first amplifier stage, and

a second tunable tuning circuit, and

the second variably tunable tuning circuit includes:

a third tunable tuning circuit,

a second amplifier stage, and

a fourth tunable tuning circuit.

10. (New) The radio receiver according to claim 6, wherein:

the frequency converter stage includes:

a mixing stage,

an oscillator amplifier stage,

an isolating amplifier,

a divider capable of being programmed via a data bus, and

a PLL stage.

Remarks

This Preliminary Amendment cancels original claims 1 to 7, without prejudice, in the underlying PCT Application No. PCT/DE99/02769, and cancels substitute claims 1-5, without prejudice. The Preliminary Amendment also adds new claims 6-10. The new claims conform the claims to U.S. Patent and Trademark Office rules and do not add new matter to the application.

In accordance with 37 C.F.R. § 1.121(b)(3), the Substitute Specification (including the Abstract, but without the claims) contains no new matter. The amendments reflected in the Substitute Specification (including Abstract) are to conform the Specification and

Abstract to U.S. Patent and Trademark Office rules or to correct informalities. As required by 37 C.F.R. § 1.121(b)(3)(iii) and § 1.125(b)(2), a Marked Up Version Of The Substitute Specification comparing the Specification of record and the Substitute Specification also accompanies this Preliminary Amendment. Approval and entry of the Substitute Specification (including Abstract) are respectfully requested.

The underlying PCT Application No. PCT/DE99/02769 includes an International Search Report, dated February 9, 2000 and an International Preliminary Examination Report dated September 25, 2000, copies of which are submitted herewith.

Applicants assert that the subject matter of the present application is new, non-obvious, and useful. Prompt consideration and allowance of the application are respectfully requested.

Respectfully Submitted,

KENYON & KENYON

By: Dr. Ingeborg (Reg. No. 41,172)

Dated: 3/2/01

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RADIO RECEIVER

The invention relates to a radio receiver having a tuning stage that is connected to a receiving antenna and that can be variably tuned using a tuning signal, a frequency conversion stage having a mixing oscillator that can be controlled by the tuning signal for converting the received high-frequency signals into a defined intermediate frequency position, and having additional processing stages for the formation of an audible low-frequency signal.

For many years, radio receivers have been equipped with a construction of this design. The respective tuning stage is dimensioned such that with the aid of the tuning signal the variable tuning is enabled over a relevant reception range. In a corresponding manner, the mixing oscillator of the frequency converter stage can be variably tuned in order to convert the high frequency selected using the tuning stage into the intermediate frequency defined in the radio receiver device. In order to achieve good tuning characteristics, in this context tuning stages are preferably used that are made up of a first variably tunable tuning circuit, an amplifier stage, and a second variably tunable tuning circuit.

Since in different countries different reception ranges are allocated, for example, for VHF reception, it is necessary to construct the radio receiver devices for the countries in question as different types in order to enable an optimal matching of the tuning stage used to the frequency band used in the country in question. This leads to the necessity of warehousing separate types of radio receiver devices. In the case of automobile radios, there arises the additional disadvantage that when the automobile in question is brought into a corresponding different country, radio reception with the built-in car radio is only partially possible, or is no longer possible at all, without modifying the radio.

For example, the frequency band for VHF reception in the European countries is located between 87.5 and 108 MHz, whereas the comparable frequency band in Japan is located between 76 and 90 MHz. It can be seen that a receiver provided for Europe will, in Japan, be able to receive only a small edge region of the frequency band used there.

A broader design, conceivable in itself, of the tuning stage in order to cover the entire frequency band in question – between 76 and 108 MHz – would be possible at a reasonable expense for the tuning circuit only at the expense of the tuning characteristics of the tuning stage, and is therefore not a possibility.

The invention is therefore based on the problem of constructing a radio receiver of the type named above in such a way that the reception of radio signals of the same type, in particular VHF signals in different bands having band boundaries that differ from one another and that in general overlap, is possible without loss of the tuning characteristics of the tuning stage.

On the basis of this problem, a radio receiver of the type named above is according to the present invention characterized in that at least two parallel tuning units are connected to the receive antenna, which units can be switched effective separately and whose outputs are connected with the common frequency converter stage via a changeover switch, and in that the mixing oscillator is constructed to be switchable by a changeover switch to one of the tuning units in its tuning range.

The radio receiver according to the present invention is, thus, a multi-norm receiver that can in particular receive VHF radio transmissions in bands having different band boundaries. For the bands in question having different band boundaries, at least two parallel tuning units are provided that can be switched effective separately, so that feedback to the other tuning unit can be prevented.

With the selection of the effective tuning unit, a corresponding changeover of the mixing oscillator is carried out in the frequency converter stage. For this purpose, the mixing oscillator is usefully provided with a tap that can be switched effective or ineffective for the purpose of the changeover.

The invention thus enables the radio receiver to be operated in different countries in which different band boundaries are defined for the reception of radio signals of a particular type, for example VHF radio signals. Of course, the invention can also be used for different band boundaries in the medium-wave, shortwave, or long-wave ranges.

In a particularly useful specific embodiment of the present invention, the receiving antenna can be switched effective, via a coupling capacitor and a switch, only for the tuning unit connected with the frequency converter stage via the changeover switch. The respectively unused tuning unit is disconnected from the receiving antenna using the coupling capacitor, which can be connected to ground. Through the dimensioning of the coupling capacitors, it can be ensured that the disconnected tuning circuit does not influence the connected tuning circuit.

In a preferred specific embodiment of the present invention, the mixing oscillator is constructed so as to be able to be changed over, in such a way that for a receiving range of a first tuning unit its frequency can be adjusted below the receiving frequency by the intermediate frequency, and for a receiving range of a second tuning unit its frequency can be adjusted above the receiving frequency by the quantity of the intermediate frequency.

Through this selection of the frequency positions of the mixing oscillator, disturbing influences due to the oscillator frequencies can be reduced.

In the following, the invention is explained in more detail on the basis of an exemplary embodiment shown in the drawing.

The drawing shows a schematic representation of the tuning stages that are essential for the inventive radio receiver.

In the exemplary embodiment shown, two tuning units 2, 3 are connected in parallel to a receiving antenna 1. For this purpose, tuning units 2, 3 each have a coupling capacitor 21, 31 whose end that is not connected to the receiving antenna 1 can be connected to ground via a switch 22, 32. The connection point between coupling capacitor 21, 31 and switch 22, 32 is connected with a first tuning circuit 23, 33 that can be controlled by a tuning signal V_T. The output signal of this tuning circuit flows, via a preamplifier 24, 34, to a second tuning circuit 25, 35 that can be tuned using tuning signal V_T. The outputs of the two second bandpasses 25, 35 are connected with two contacts of a changeover switch 4, whose output contact forms an input of a frequency converter stage 5 that is fashioned as an integrated circuit. The frequency converter stage 5 has a mixing stage 51 at whose output the defined intermediate frequency

ZF appears, which frequency is 10.7 MHz for the VHF reception depicted here. A second input of mixing stage 51 is supplied with an oscillator signal that is produced by an oscillator stage 52, which is integrated in frequency converter stage 5, and by an externally connected frequency-determining oscillator circuit 6. Oscillator circuit 6 is composed, in a known way, of an oscillator coil 7 having two partial windings 71, 72, at whose connection point a tap 73 is provided that can be connected to ground parallel to partial winding 72, using a switch 74.

Parallel to oscillator coil 7, an oscillator capacitor 8 is connected to ground, said capacitor being made up, in a known manner, of two variable capacitance diodes 81, 82 connected in antiparallel fashion. Tuning voltage V_T can be supplied to the connection point of the two variable capacitance diodes 81, 82, the capacitance of variable capacitance diodes 81, 82, and therewith the frequency of oscillator 6, being adjustable through this voltage.

Tuning voltage V_T is produced in a known manner with the aid of a phase locked loop (PLL) 53, in which tuning signal V_T can be controlled via a controllable frequency divider 54, to which the output signal of the oscillator at the output of amplifying oscillator stage 52 is supplied via an isolating amplifier 55. For the purpose of tuning, the adjustment of frequency divider 54 is controlled in a known manner by a microprocessor (not shown), via a control bus 56.

Intermediate frequency signal ZF, produced in frequency converter stage 5, is further processed in the radio receiver device, in a sufficiently known manner, and is converted into a low frequency that can be reproduced by a loudspeaker, headphones, or the like.

The drawing shown indicates the settings of switches 22, 32, 4, 74 for the switching effective of first tuning unit 2. Due to opened switch 22, receiving antenna 1 is here connected with tuning unit 2, which is switched effective, via coupling capacitor 21, said connection achieving the coupling of the received signal into tuning unit 2. In this context, closed switch 32 effects the switching off and decoupling of second tuning unit 3 from receive antenna 1.

Through tuning circuits 23, 25, a standard selective filtering takes place, the mid-frequency of tuning circuits 23, 25 being set through tuning signal V_T. The receive signal selected in this way flows, via changeover switch 4, which is closed at the output of second tuning circuit 25,

into frequency converter stage 5, and is there supplied to mixing stage 51. The oscillator signal of frequency-determining oscillator circuit 6 is supplied to the second input of mixing stage 51 via amplifying oscillator stage 52. At oscillator circuit 6, due to closed switch 74 only partial winding 71, which determines frequency range and thus reception range, is effective. Inside mixing stage 51, the intermediate frequency signal is formed from these two signals, said intermediate frequency signal being used by the further processing stages to form an audible low-frequency signal.

In the exemplary embodiment shown, first tuning unit 2 can for example be designed for the VHF band used in Europe, between 87.5 and 108 MHz.

If, for example, the inventive radio receiver is to be used in Japan, where the VHF band is located between 76 and 90 MHz, a changeover is carried out to the switching effective of second tuning unit 3. In relation to the depiction in the drawing, for this purpose switches 22, 32, 4, 74 are each switched into the other position, so that receiving antenna 1 is henceforth decoupled from first tuning unit 2 by coupling capacitor 21 and closed switch 22, and the receive signal from receiving antenna 1 is processed in second tuning unit 3 via coupling capacitor 31. Apart from the fact that this tuning unit 3 is designed for the desired frequency range, for example between 76 and 90 MHz, the processing takes place in the same manner as was described above for first tuning unit 2. Changeover switch 4, which is henceforth closed to the output of second tuning circuit 35, connects second tuning unit 3 with frequency converter stage 5. Opened switch 74 has the effect that overall coil 7, formed from the connection in series of the two partial windings 71, 72, is effective in oscillator circuit 6, resulting in the required frequency changeover.

For the formation of tuning signal V_T, the microprocessor (not shown) sets the currently applicable divider ratios at frequency divider 54 via control bus 56.

The changeover of oscillator circuit 6 is preferably carried out such that for the receive frequency range of the first tuning unit (87.5 to 108 MHz) it can be variably tuned between approximately 98 and 119 MHz, in order to produce the intermediate frequency of 10.7 MHz. In this case, the frequency of oscillator circuit 6 is therefore higher than the frequency of the signals received at receive antenna 1.

For the receive band of second receiver unit 3 (for example, 76 to 90 MHz), the variable tuning frequency of the oscillator is, in contrast, preferably located at 64 to 79 MHz; i.e., 10.7 MHz below the receive frequency.

The specified exemplary embodiment is provided for two different receive bands. Of course, it is unproblematically possible and useful to provide, for three or more receive bands, a correspondingly higher number of tuning units, and, if necessary, a corresponding number of changeovers of oscillator circuit 6.

New Patent Claims

1. A radio receiver device having at least two variably tunable tuning stages (2, 3), for two receiving ranges, that are connected to a receiving antenna (1) and that can be switched effective separately,
having a changeover switch (4) for the optional connection of one of the tuning stages (2, 3) with a frequency converter stage (5) having a mixing oscillator (6) for the conversion of received high-frequency signals into a defined intermediate frequency, the mixing oscillator (6) being able to be changed over in its tuning range, using a changeover device, to one of the tuning stages (2, 3) in such a way that for a first receiving range of the first tuning unit (2) its oscillation frequency can be set above the frequency to be received by the quantity of the intermediate frequency, and for a second receiving range of the second tuning unit (3) its oscillation frequency can be set below the frequency to be received by the quantity of the intermediate frequency.

2. The radio receiver as recited in Claim 1,
characterized in that the mixing oscillator (6) is fashioned having an oscillator coil (7) that is provided with a tap (73), and in that the mixing oscillator (6) can be changed over through a switching effective or switching ineffective (74) of the tap (73).

3. The radio receiver as recited in Claim 1 or 2, characterized in that the receiving antenna (1) can be switched effective, respectively via a coupling capacitor (21, 31) and a switch (22, 32), only for the tuning stage (2, 3) connected with the frequency converter stage (5) via the changeover switch (4).

4. The radio receiver as recited in one of the preceding claims,
characterized in that the tuning stages (2, 3) each have a first tunable tuning circuit (23, 33), an amplifier stage (24, 34), and a second tunable tuning circuit (25, 35).

5. The radio receiver as recited in one of the preceding claims,
characterized in that the frequency converter stage (5) has a mixing stage (51), an oscillator amplifier stage (52), an isolating amplifier (55), a divider (54) that can be programmed via a data bus, and a PLL stage (53).

Abstract

A radio receiver having a tuning stage (2, 3) that is connected to a receiving antenna (1) and that is tunable using a tuning signal (V_T), a frequency converter stage (5) having a mixing oscillator (6) that can be controlled by the tuning signal (V_T) in order to convert the received high-frequency signals into a defined intermediate frequency (ZF), and having further processing stages for the formation of an audible low-frequency signal, can be used for different band ranges in different countries without loss of the tuning characteristics of the tuning stage (2, 3) in that at least two parallel tuning units (2, 3) are connected to the receiving antenna (1) that can be switched effective separately and whose outputs are connected, via a changeover switch (4), with the common frequency converter stage (5), and in that the mixing oscillator (6) is fashioned so as to be able to be changed over in its variable tuning range, using the changeover to one of the tuning units (2).

RADIO RECEIVER

Field Of The Invention

The present invention relates to a radio receiver having a tuning stage that is connected to a receiving antenna and that can be variably tuned using a tuning signal, a frequency conversion stage having a mixing oscillator that can be controlled by the tuning signal for converting the received high-frequency signals into a defined intermediate frequency position, and having additional processing stages for the formation of an audible low-frequency signal.

Background Information

For many years, radio receivers have been equipped with a construction of this design. The respective tuning stage is dimensioned such that with the aid of the tuning signal the variable tuning is enabled over a relevant reception range. In a corresponding manner, the mixing oscillator of the frequency converter stage can be variably tuned in order to convert the high frequency selected using the tuning stage into the intermediate frequency defined in the radio receiver device. In order to achieve good tuning characteristics, in this context tuning stages are preferably used that are made up of a first variably tunable tuning circuit, an amplifier stage, and a second variably tunable tuning circuit.

Since in different countries different reception ranges are allocated, for example, for VHF reception, it is necessary to construct the radio receiver devices for the countries in question as different types in order to enable an optimal matching of the tuning stage used to the frequency band used in the country in question. This leads to the necessity of warehousing separate types of radio receiver devices. In the case of automobile radios, there arises the additional disadvantage that when the automobile in question is brought into a corresponding different country, radio reception with the built-in car radio is only partially possible, or is no longer possible at all, without modifying the radio.

For example, the frequency band for VHF reception in the European countries is located between 87.5 and 108 MHz, whereas the comparable frequency band in Japan is located between 76 and 90 MHz. It can be seen that a receiver provided for Europe will, in Japan, be able to receive only a small edge region of the frequency band used there.

A broader design, conceivable in itself, of the tuning stage in order to cover the entire frequency band in question – between 76 and 108 MHz – would be possible at a reasonable expense for the tuning circuit only at the expense of the tuning characteristics of the tuning stage, and is therefore not a possibility.

The present invention is therefore based on the problem of constructing a radio receiver of the type named above in such a way that the reception of radio signals of the same type, in particular VHF signals in different bands having band boundaries that differ from one another and that in general overlap, is possible without loss of the tuning characteristics of the tuning stage.

On the basis of this problem, a radio receiver of the type named above is according to the present invention characterized in that at least two parallel tuning units are connected to the receive antenna, which units can be switched effective separately and whose outputs are connected with the common frequency converter stage via a changeover switch, and in that the mixing oscillator is constructed to be switchable by a changeover switch to one of the tuning units in its tuning range.

The radio receiver according to the present invention is, thus, a multi-norm receiver that can in particular receive VHF radio transmissions in bands having different band boundaries. For the bands in question having different band boundaries, at least two parallel tuning units are provided that can be switched effective separately, so that feedback to the other tuning unit can be prevented.

With the selection of the effective tuning unit, a corresponding changeover of the mixing oscillator is carried out in the frequency converter stage. For this purpose, the mixing oscillator is usefully provided with a tap that can be switched effective or ineffective for the

purpose of the changeover.

The present invention thus enables the radio receiver to be operated in different countries in which different band boundaries are defined for the reception of radio signals of a particular type, for example VHF radio signals. Of course, the present invention can also be used for different band boundaries in the medium-wave, shortwave, or long-wave ranges.

In a particularly useful specific embodiment of the present invention, the receiving antenna can be switched effective, via a coupling capacitor and a switch, only for the tuning unit connected with the frequency converter stage via the changeover switch. The respectively unused tuning unit is disconnected from the receiving antenna using the coupling capacitor, which can be connected to ground. Through the dimensioning of the coupling capacitors, it can be ensured that the disconnected tuning circuit does not influence the connected tuning circuit.

In a preferred specific embodiment of the present invention, the mixing oscillator is constructed so as to be able to be changed over, in such a way that for a receiving range of a first tuning unit its frequency can be adjusted below the receiving frequency by the intermediate frequency, and for a receiving range of a second tuning unit its frequency can be adjusted above the receiving frequency by the quantity of the intermediate frequency.

Through this selection of the frequency positions of the mixing oscillator, disturbing influences due to the oscillator frequencies can be reduced.

Brief Description Of The Drawing

The Figure shows a schematic representation of the tuning stages that are essential for the inventive radio receiver of the present invention.

Detailed Description

In the exemplary embodiment shown, two tuning units 2, 3 are connected in parallel to a receiving antenna 1. For this purpose, tuning units 2, 3 each have a coupling capacitor 21, 31 whose end that is not connected to the receiving antenna 1 can be connected to ground via a

switch 22, 32. The connection point between coupling capacitor 21, 31 and switch 22, 32 is connected with a first tuning circuit 23, 33 that can be controlled by a tuning signal V_T. The output signal of this tuning circuit flows, via a preamplifier 24, 34, to a second tuning circuit 25, 35 that can be tuned using tuning signal V_T. The outputs of the two second bandpasses 25, 35 are connected with two contacts of a changeover switch 4, whose output contact forms an input of a frequency converter stage 5 that is fashioned as an integrated circuit. The frequency converter stage 5 has a mixing stage 51 at whose output the defined intermediate frequency ZF appears, which frequency is 10.7 MHz for the VHF reception depicted here. A second input of mixing stage 51 is supplied with an oscillator signal that is produced by an oscillator stage 52, which is integrated in frequency converter stage 5, and by an externally connected frequency-determining oscillator circuit 6. Oscillator circuit 6 is composed, in a known way, of an oscillator coil 7 having two partial windings 71, 72, at whose connection point a tap 73 is provided that can be connected to ground parallel to partial winding 72, using a switch 74.

Parallel to oscillator coil 7, an oscillator capacitor 8 is connected to ground, said capacitor being made up, in a known manner, of two variable capacitance diodes 81, 82 connected in antiparallel fashion. Tuning voltage V_T can be supplied to the connection point of the two variable capacitance diodes 81, 82, the capacitance of variable capacitance diodes 81, 82, and therewith the frequency of oscillator 6, being adjustable through this voltage.

Tuning voltage V_T is produced in a known manner with the aid of a phase locked loop (PLL) 53, in which tuning signal V_T can be controlled via a controllable frequency divider 54, to which the output signal of the oscillator at the output of amplifying oscillator stage 52 is supplied via an isolating amplifier 55. For the purpose of tuning, the adjustment of frequency divider 54 is controlled in a known manner by a microprocessor (not shown), via a control bus 56.

Intermediate frequency signal ZF, produced in frequency converter stage 5, is further processed in the radio receiver device, in a sufficiently known manner, and is converted into a low frequency that can be reproduced by a loudspeaker, headphones, or the like.

The drawing shown indicates the settings of switches 22, 32, 4, 74 for the switching effective

of first tuning unit 2. Due to opened switch 22, receiving antenna 1 is here connected with tuning unit 2, which is switched effective, via coupling capacitor 21, said connection achieving the coupling of the received signal into tuning unit 2. In this context, closed switch 32 effects the switching off and decoupling of second tuning unit 3 from receive antenna 1.

Through tuning circuits 23, 25, a standard selective filtering takes place, the mid-frequency of tuning circuits 23, 25 being set through tuning signal V_T. The receive signal selected in this way flows, via changeover switch 4, which is closed at the output of second tuning circuit 25, into frequency converter stage 5, and is there supplied to mixing stage 51. The oscillator signal of frequency-determining oscillator circuit 6 is supplied to the second input of mixing stage 51 via amplifying oscillator stage 52. At oscillator circuit 6, due to closed switch 74 only partial winding 71, which determines frequency range and thus reception range, is effective. Inside mixing stage 51, the intermediate frequency signal is formed from these two signals, said intermediate frequency signal being used by the further processing stages to form an audible low-frequency signal.

In the exemplary embodiment shown, first tuning unit 2 can for example be designed for the VHF band used in Europe, between 87.5 and 108 MHz.

If, for example, the inventive radio receiver is to be used in Japan, where the VHF band is located between 76 and 90 MHz, a changeover is carried out to the switching effective of second tuning unit 3. In relation to the depiction in the drawing, for this purpose switches 22, 32, 4, 74 are each switched into the other position, so that receiving antenna 1 is henceforth decoupled from first tuning unit 2 by coupling capacitor 21 and closed switch 22, and the receive signal from receiving antenna 1 is processed in second tuning unit 3 via coupling capacitor 31. Apart from the fact that this tuning unit 3 is designed for the desired frequency range, for example between 76 and 90 MHz, the processing takes place in the same manner as was described above for first tuning unit 2. Changeover switch 4, which is henceforth closed to the output of second tuning circuit 35, connects second tuning unit 3 with frequency converter stage 5. Opened switch 74 has the effect that overall coil 7, formed from the connection in series of the two partial windings 71, 72, is effective in oscillator circuit 6, resulting in the required frequency changeover.

For the formation of tuning signal V_T, the microprocessor (not shown) sets the currently applicable divider ratios at frequency divider 54 via control bus 56.

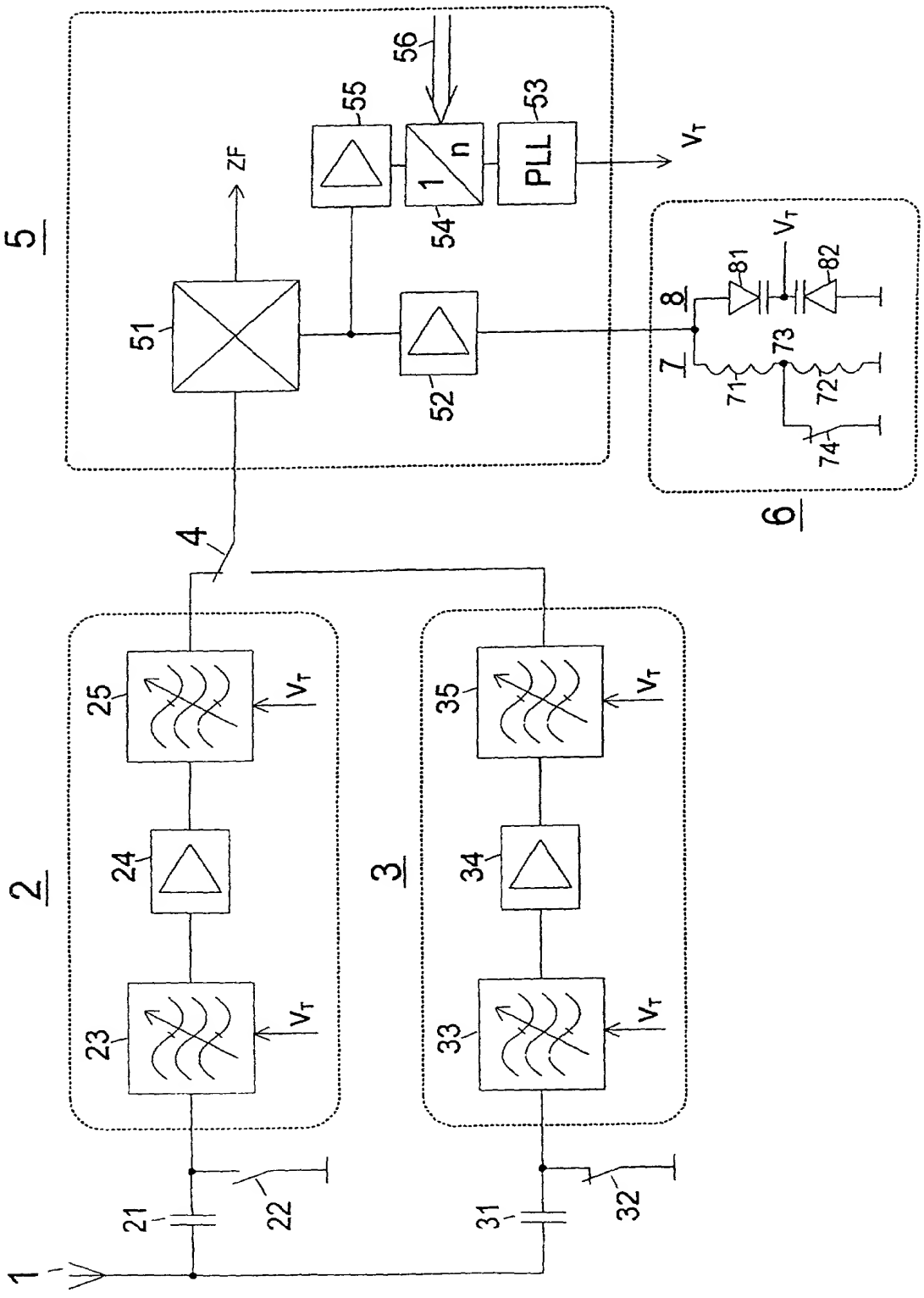
The changeover of oscillator circuit 6 is preferably carried out such that for the receive frequency range of the first tuning unit (87.5 to 108 MHz) it can be variably tuned between approximately 98 and 119 MHz, in order to produce the intermediate frequency of 10.7 MHz. In this case, the frequency of oscillator circuit 6 is therefore higher than the frequency of the signals received at receive antenna 1.

For the receive band of second receiver unit 3 (for example, 76 to 90 MHz), the variable tuning frequency of the oscillator is, in contrast, preferably located at 64 to 79 MHz; i.e., 10.7 MHz below the receive frequency.

The specified exemplary embodiment is provided for two different receive bands. Of course, it is unproblematically possible and useful to provide, for three or more receive bands, a correspondingly higher number of tuning units, and, if necessary, a corresponding number of changeovers of oscillator circuit 6.

Abstract Of The Disclosure

A radio receiver having a tuning stage that is connected to a receiving antenna and that is tunable using a tuning signal, a frequency converter stage having a mixing oscillator that can be controlled by the tuning signal in order to convert the received high-frequency signals into a defined intermediate frequency, and having further processing stages for the formation of an audible low-frequency signal, can be used for different band ranges in different countries without loss of the tuning characteristics of the tuning stage in that at least two parallel tuning units are connected to the receiving antenna that can be switched effective separately and whose outputs are connected, via a changeover switch, with the common frequency converter stage, and in that the mixing oscillator is fashioned so as to be able to be changed over in its variable tuning range, using the changeover to one of the tuning units.



DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am an original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled **RADIO RECEIVER**, the specification of which was filed as International Application No. PCT/DE99/02769 on September 1, 1999.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, § 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application(s) for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

PRIOR FOREIGN APPLICATION(S)

Number	Country Filed	Day/Month/Year	Priority Claimed Under 35 USC 119
198 39 857.3	Fed. Rep. of Germany	02 September 1998	Yes

~~EL594011594US~~
EL245834190US

And I hereby appoint Richard L. Mayer (Reg. No. 22,490) and Gerard A. Messina (Reg. No. 35,952) my attorneys with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful and false statements may jeopardize the validity of the application or any patent issued thereon.

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